The Blood,

Its Rotary Motion

AND

Centrifugal Force.

THE

ROTARY MOTION

AND

Centrifugal Power

OF THE

Circulating Blood

In the Larger Arteries.

The Blood not only moves in the direction of the Artery containing it, but also rotates on an axis parallel to the longitudinal axis of the Artery.

PREFACE.

The following pamphlet, having been written for the Medical Profession, the Author deems it superfluous to enter into or mention fundamental facts in Physiology, Physics, Mathematics, etc. To those of his friends who have been of assistance to him in furnishing material, drawings, etc., he takes this opportunity of gratefully acknowledging his indebtedness.

Up to time of going to print the third test, that on living animals, could not possibly be completed by the author, the instrument to be used is very simple and when the experiments shall have been made, he will publish the results in some Medical Journal.

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San Francisco, June 20th, 1892.

696 Baker Street,

The Blood,

ITS ROTARY MOTION

AND

Centrifugal Force.

In order to prove the existence of a Rotary Motion in the blood, and in consequence a Centrifugal Power there are three courses open to us, the demonstration of any one of which must be accepted as absolute proof. First. If this rotary motion can be proven to be an absolute necessity to health and Life 'twill be sufficient as our very presence is the best evidence. Second. If it be found that the mechanism of the heart and circulatory system cannot propel the blood in any other way than with a rotary motion, the same as a rifled cannon cannot project its projectile without imparting a rotary motion to the same, the theory is irrefutable; or Third. If it can be shown by means of mechanical device placed in the blood current of the living animal, that the blood rotates on itself as well as flows forward, the theory must be accepted as a

Jack.

Lastly, if all three propositions are demonstrated the evidence must be accepted as absolutely conclusive.

The factors and forces that act and are acted upon vary so much in different portions of the circulation, that it is convenient to divide the circulation for our purpose into three divisions, Pulmonary, Arterial and Venous.

The Pulmonary, that beginning at the right Auricle until the blood reaches the capillaries of the lungs.

The Arterial, beginning with the blood after it leaves the left Auricle until it reaches the next following capillaries.

The Venous, which includes the circulation of the blood after it leaves the pulmonary and arterial capillaries until it reaches the left and right Auricles respectively.

This last division we here dismiss as it does not take part in the theory under consideration, the blood in this division does not require the rotary motion, or a centrifugal force, therefore there are no means for imparting the same to it. A negative proof of the correctness of the theory.

The distinguishing difference between the pulmonary and arterial circulation to be emphasized here is, that the Pulmonary is short and induced by two forces, (a) the propulsive power of the systole of the right Ventricle, and (b) the aspiratory force of the thoracic cavity; whereas, the Arterial circulation is long and caused by the propulsive power of the systole of the left Ventricle only. The left ventricle having many times the quantity of resistance to overcome that the right has, nature therefore provided us with a powerful left and a much less powerful right ventricle.

THE ROTARY MOTION NECESSARY IN THE PULMONARY CIRCULATION.

The blood that enters the right auricle is composed of many distinctly different streams; we find that the Hepatic, Iliac, Renal, Spermatic, Lumbar veins, etc., from below, and the Innominate veins containing contents of Thoracic Duct, etc. from above, all enter the right auricle, each one of these streams of blood must of necessity vary greatly from the other, in specific gravity, and in number and character of constituents. This heterogeneous mass of blood must be reduced to a homogeneous condition before entering the lungs, in order that perfect oxygination take place, and also because were it not a homogeneous mass, that portion with the greatest specific gravity would flow along the bottom of the blood vessel, and with less celerity than that portion of lighter specific gravity. There would also follow eddies and accumulations of the more solid constituents of the current at the angles and projections where the arteries branch in all directions, and the blood current of the pulmonary circulation changes its direction more or less suddenly at every point. This part of subject will be more fully entered into under heading of "Necessity of Centrifugal Power of Blood Current in all Arteries."

THE ROTARY MOTION NECESSARY IN THE ARTERIAL CIRCULATION.

The oxygenated blood in the pulmonary veins as they empty into left auricle, varies in health and in disease in the different veins as to quantity of contained oxygen. For in health when standing, sitting, or stooping, lying on one side or other, carrying weights, or pulling, push-

ing, etc., etc., respiration and consequent oxygenation of blood is more active in one or other portion of lung than in other lobes. In disease of lungs or portion of lung most certainly so. The advantage, yes, the absolute necessity of having these *varying* streams of blood reduced to a homogeneous mass before entering the circulation needs to be mentioned only to be perceived and accepted. How thoroughly, quietly, and without disturbance the rotary movement imparted by the heart to the blood brings about this result needs no proof, but will be explained further on.*

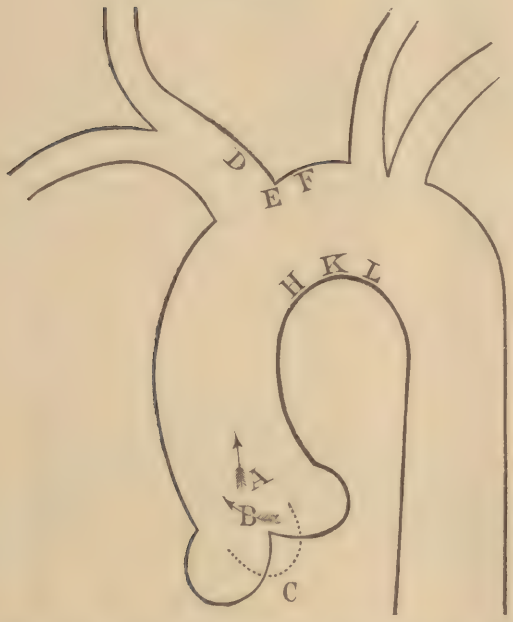
THE ROTARY MOTION AND CENTRIFUGAL FORCE OF THE BLOOD ABSOLUTELY NECESSARY IN THE PULMONARY ARTERY AND AORTA, AND THEIR BRANCHES.

In both Pulmonary and Arterial systems, specialy Pulmonary Artery and Aorta and their immediate branches, where the current is not only under great pressure but must of necessity be very powerful,‖ the injury to the walls of these blood vessels, that a powerful and suddenly intermitting, straight moving current would cause cannot be over-estimated. Figure 1 represents Aorta and principal branches. Let us suppose a straight moving current of blood entering in the direction of the arrow A [in reality the blood is ejected into the Aorta in the direction of the arrow B.] This current would

* The teaspoon at the breakfast table, when stirring the coffee to produce a thorough mixture of coffee, milk and sugar, illustrates, very practically, the value of a rotary motion to reduce liquids to a homogeneous mass.

‖ In looking up the subject, the author has found that Physiologists have not emphasized sufficiently the difference between blood current and blood pressure, we can have a slow current of blood with great pressure or a fast current with little or no pressure, and *vice versa*.

Figure I.

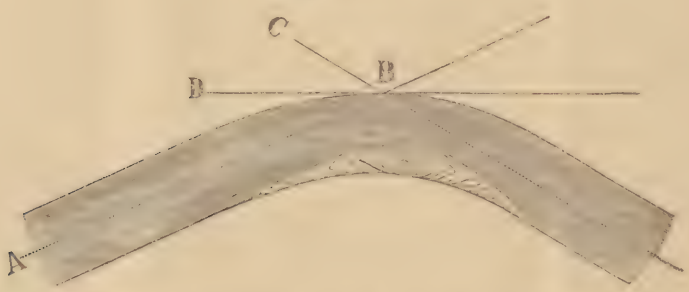


necessarily send first an increase pressure wave through Aorta and branches, and second, strike the wall with its powerful impaction force at D. E. F., destroy the angle and wall in a short time, and aneurism and death would soon follow, if health and life itself would not be extinct long before, through the formation of clot and embolism. The same results would follow in any portion of the Pulmonary or Arterial system of arteries, until the current force is practically lost.

We must bear in mind that we have to do with a liquid, the blood, that easily, at the slightest provocation coagulates, the finest wire introduced into the artery and

ever so slightly interrupting the current, will cause a deposit of coagulated fibrin to gather about it. These and similar facts are too well known to be mentioned here. At H. K. L. where the current would tend to leave the wall of the vessel, a strong eddy and whirl, and perhaps bubbling would take place, all also absolutely inconsistent with health and life itself. The Aorta and Pulmonary artery besides being curved are twisted into a spiral form which enhances the complications spoken of

Figure II.



above. Fig. 2 presents a blood vessel curved on itself and a straight current stream of blood flowing through in direction of arrow A. The blood necessarily strikes the outer convex surface at the bend, and also seeking to follow in its original direction it lifts itself off of the opposite portion of the wall, on this portion of the wall of blood vessel a whirlpool would necessarily exist as far as where the current would regain its straight course as seen in diagram. To recapitulate: The rotary motion is absolutely necessary to reduce the various varieties of venous blood to a homogeneous constituency, to render uniform the arterial blood from the Pulmonary veins, to make the Pulmonary and arterial currents free from whirls,

eddies, stagnant pools, etc., etc., and to preserve intact the form, calibre and integrity of the pulmonary artery and Aorta together with their branches, in short *all blood vessels* that pusate.

THE BLOOD THAT LEAVES THE HEART POSSESSES A ROTARY MOTION.

The Heart Cannot Eject Its Contents Without Imparting A Rotary Motion To The Same.

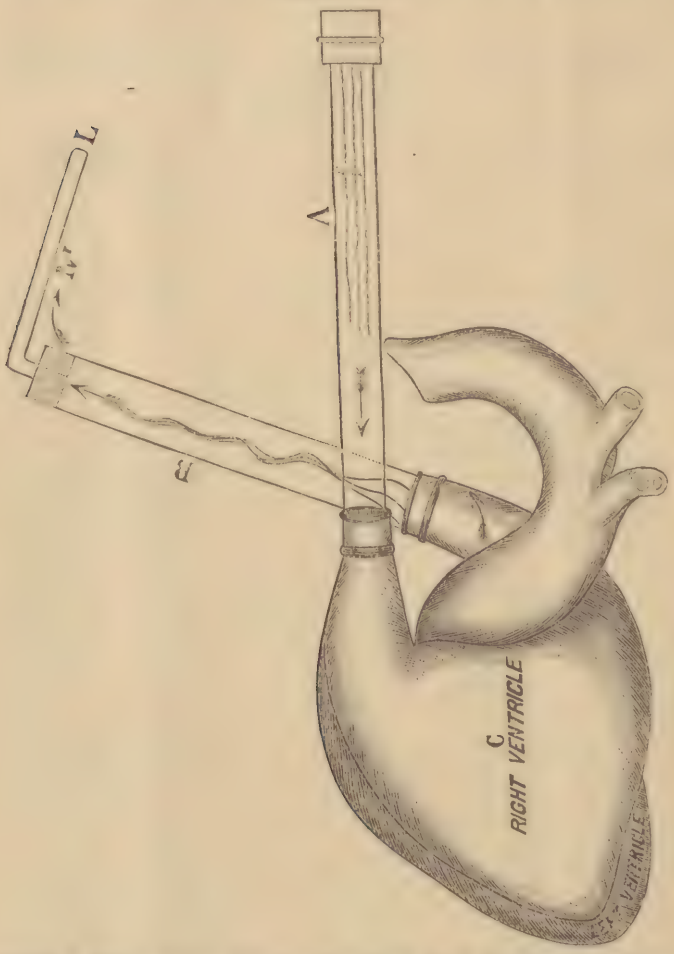
Not only does the blood possess a rotary motion when leaving the heart, but the heart cannot eject its contents without imparting to it a screw-like or rotary motion.

The Rotary Motion in Pulmonary Circulation.

In Figure (3) A and B represent two glass tubes each containing three long silk threads fastened to outside of tube at one end, and equidistant from one another. These glass tubes are inserted and thoroughly fastened into right auricle and pulmonary artery respectively of a human heart, as in diagram, the free end of tube A through superior vena cava into right auricle, and the threaded end of tube B into pulmonary artery [the inf. v. c. etc., is ligated]. A practically straight current of water is now caused to flow through tube A; as shown in diagram the water flows in the direction of the arrows through right ventricle, through tube B and out at L. The bent tube M is inserted into tube B to increase the pressure within the tubes. We find that the silk threads D, E, F, in tube A *straighten out* and float in the current with a more or less tremulous motion, while the similar threads in tube B, *twist themselves into a right-handed spiral*, and even form a rope or twine, and always twist and form a twine

in the *same direction*, on the anterior surface of tube [position as shown in diagram] from below up and posterior

Figure III.



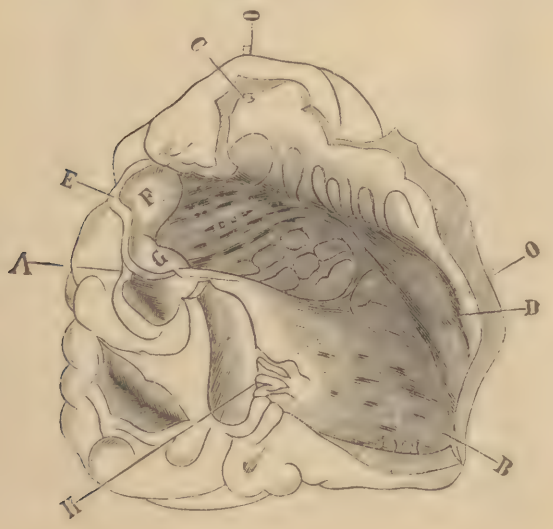
surface from above down, denoting that the current flowing through tube A flows in direction of the tube; the

current in tube B, after having passed through the right ventricle flows, 'tis true, forward through this tube, *but at same time* revolves on an axis parallel to the longitudinal axis of this tube. If we, by means of the hand, try to imitate crudely the systole of the heart by expressing the contents of the right ventricle from left to right, or as shown in diagram from below up [in the direction of the muscular fibres of the right ventricle] we increase the rotary action of the current so greatly that the threads in tube B, almost tie up in a knot.

How the Rotary Motion is Produced in the Pulmonary Circulation.

If the right ventricle of the heart of an ox be opened at its lower border in its entire length from apex to auricle, and also along the auricular border to pulmonary artery, and this wall of artery opened, (See Fig. 4) we find that

Figure IV.



the cavity of the right ventricle has the peculiar form of a spiral horn flattened on one side, lying partly on its edge, wide end below and point end up.

On examining the interior of the right ventricle, we find before us an inner and outer wall. (Fig. 4.) The inner wall, that, immediately surrounding the left ventricle, is composed of muscular fibres forming a smooth floor or surface; these fibres run at right angles to the course of the blood current, therefore, the only effect they can possibly exert by their contractions on that portion of the blood lying next to them, is to lessen the space over which this mass of blood must pass, and thereby accelerate its passage, therefore it can only accelerate the portion nearest the apex of the heart, and the nearer the base, the less power [or no power whatsoever] it exerts. This mass of muscle is carried from left to right by the untwisting of the left ventricle at its systole, and in this way this floor of the right ventricle exerts a powerful force in forwarding the contents furthest from base of heart towards the pulmonary artery. The outer wall is composed of *reticulated* fibres which run in the direction of the current, therefore the outer portion of the mass of blood expelled by the right ventricle, receives a greater momentum than the inner portion; and the portion nearest apex the greatest momentum. Again, it must of necessity travel faster than the *floor* portion because it has more than twice the distance to travel in the same time. Also, as before mentioned, that portion of blood contained in right ventricle, lying at junction of outer and inner wall of right ventricle furthest distant from base of heart must travel nearly four times as fast as the portion lying near the base of heart, because of the longer distance to travel in the same time, the systole of the heart. Fig. 4.

represents right ventricle opened and outer wall C, D, partly drawn to one side; E, beginning of Pulmonary Artery; F and G, Pulmonary Valves; H, one of the Tricuspid Valves; A and B, the inner wall of Right Ventricle.

Bearing in mind two facts: first, that the heart must expel all of its contents at the same time, and secondly, the anatomy of the right ventricle, as shown in fig. 4, we see that the portion of blood lying on the inner wall A, B, does not need to travel as quickly as the portion on the outer wall C, D, nor can it, as the portion on A, B, receives its momentum largely through C, D, and the portion C, D, has comparatively no friction to overcome, while A, B, portion has nearly all friction. Just before the blood reaches the pulmonary artery, the outer C, D, portion is still more accelerated in its movement, and the rotary motion of the entire mass thereby greatly accentuated, by the action of the wall C, D, whose muscular fibres here twist and form a spiral on themselves, sending the blood with a curve in a direction almost at right angles to its former course and into the pulmonary artery. Again the flattened side of this horn [the side A, B,] is rolled diagonally around a cone, *the apex of which is at the bottom*, and it (the right ventricle) *begins at apex of cone and ends at base* [this cone is the left ventricle.] At every systole the apex half of cone untwists itself from left to right making this flat surface of horn A, B, move faster at its convex and outer edge than at its concave and inner one, which materially assists in giving this rotary motion to the blood. These factors cause the blood to leave the right ventricle at each systole with a rotary movement just the same as a rifled cannon imparts a rotary motion to its projectiles. The pulmonary artery receives this rotary moving blood and not only keeps up this rotary

motion, by means of *its form*, (2) its *elasticity*, and (3) its *apposition to the Aorta*, but each of these factors accentuates it.

To enumerate the different means by which the right ventricle imparts a rotary movement to its contents at each systole, we have (1) Its form, one side short, like half circumference of hub of wheel, and the other side long, like corresponding half of rim of wheel. (2) Its position on a cone with its apex below, partly surrounding the left ventricle from apex spirally around and upwards to base, forming a spiral stair, or better a spirally inclined plane. (3) Its peculiar arrangement of muscular fibres and consequent mode of action, one surface or muscular wall forcing blood to move, and the other surface allowing the blood to move on it. (4) The untwisting of left ventricle most extensive nearest apex, therefore greatest action on outer curve of spiral or wheel or convex curve of horn. [5, 6 & 7, the form, the elastic quality and apposition of pulmonary artery to aorta at its origin will be spoken of further on.]*

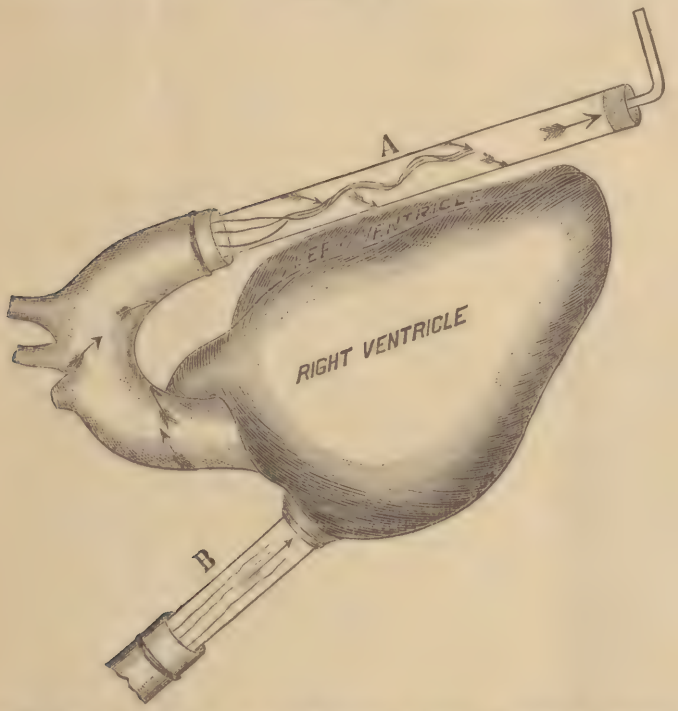
THE ROTARY MOTION IN ARTERIAL CIRCULATION.

(Figure 5.) The two glass tubes A & B, previously used are inserted into left Auricle and Aorta respectively, the tube A, with threaded end in Aorta and tube B, with free end in left auricle, all other openings are ligated so that water made to pass through tube B, must pass out through tube A. We find here the same phenomenon

* In making dissections of hearts of lambs, calves and oxen, it has often appeared to the author that he could distinguish two and sometimes three separate and distinct compartments in both right and left ventricles, as if the internal muscular fibres of the ventricles were so arranged that they forced the blood out with a screw motion like the screw of a steamer in two and three-bladed streams, *i. e.*, two or three separate streams working together like an augur.

take place on making current of water pass through B, in direction of arrows the threads in tube B remain apart

Figure V.



and float straight in the stream, those in tube A twirl up, form a rope, and the rope itself forms a right-handed spiral as shown in the diagram. If, we here also imitate the systolic condition of the left ventricle by holding the same contracted, the twirling of the threads is intensely increased. The rotary motion is from above downwards anteriorly in transverse portion of arch of Aorta, and posteriorly from below up, necessarily if we make the water the specific gravity of the blood, the force on the threads would be increased and the phenomenon be still

more pronounced, and as will be proven further on, were we to force water through right and left ventricles at the same time, the rotary motion of the currents in Pulmonary Artery and Aorta would be still more accentuated.

HOW THE ROTARY MOTION IS PRODUCED IN THE ARTERIAL CIRCULATION.

As mentioned before, the Arterial Circulation is induced by the left ventricle only. This division of the circulatory system requires a much more powerful heart than the Pulmonary Circulation, because the friction and resistance to the circulating blood is so much greater and therefore more difficult to overcome. In consequence we find the left ventricle larger, more compact and many times more powerful, and the mechanism to produce the rotary motion, though differently devised, to be just as thorough in its performance as that in the Pulmonary Circulation, and none the less suitably and admirably arranged to accord with the powerful mechanism of the left ventricle. A good simile and one understood by our American Confreres would be to liken the twirl given to the blood by the left ventricle to the twirl given to the baseball by the pitcher with his ring and little fingers just before the ball leaves the hand. At the moment of contraction, the left ventricle untwists its apex from left to right and upwards * in the same direction that the bloods flows through the right ventricle, and expels the blood with a rotary motion and twirl against the large mitral valve, which is of such a form and is so acted upon by the chordæ tendineæ and musculi papillares that it

* This untwisting has been referred to before as assisting the right ventricle to twirl and forward its contents, inasmuch as the untwisting is necessarily greater below near the apex than above near the base.

accentuates the twirl and furthers it against that side of the Aorta opposite to that adjoining the pulmonary artery, that is, the blood enters Aorta over that Aortic valve, which has *no coronary artery* opening back of it, it then twirls around partly entering coronary arteries back of the other valves *at systole*, to continue its forward circulation with a rotary motion.

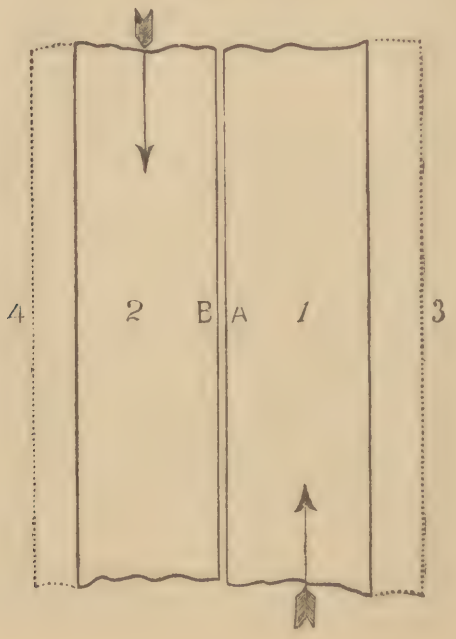
MECHANISM COMMON TO BOTH PULMONARY AND ARTERIAL CIRCULATION FOR PRODUCING ROTARY MOTION.

The Aorta and Pulmonary Artery twist about each other, this twisting in each separately is of itself sufficient to cause a straight current to rotate, and a current previously rotating in similar direction to rotate still more rapidly, and when they twist on each other under the circumstances that exist in the arterial system, as these two Arteries do, the rotary motion is still more accentuated, in fact brought to greater perfection as can be seen in following explanation and diagram. The Aortic Current crosses that of the Pulmonary Artery at about a right angle, and admitting that both currents rotate and rotate in same direction, we find that each current tends to accentuate the rotary motion of the other, and as the point of apposition is only on one side of each current it must necessarily tend to curve the current over itself, *i. e.*, the Aortic Current increases the rotary action of the current of blood in Pulmonary Artery and also causes it to curve around the Aorta by exerting its pressure on one side of Pulmonary Artery only, * thus somewhat relieving the

* This phenomenon is well illustrated and almost unconsciously understood even by children in hoop spinning, by slightly touching a revolving hoop on one side or other, the hoop is made to change its direction because the friction between stick and hoop is on one side only.

outer wall of the Pulmonary to a certain degree of intra-arterial pressure. The Pulmonary Artery Current acts on the Aortic current in a corresponding manner, but of course much less powerfully. Again, that portion of the mass of blood ejected from the left ventricle which strikes the outer wall of the Aorta, so-called in comparison to inner wall adjoining Pulmonary Artery, flows much more rapidly than the other, *i. e.*, it circulates around the portion that strikes the wall adjoining the Pulmonary Artery, because the latter comes in contact with an *opposing pressure* from the Pulmonary Current which is synchronously ejected from the right ventricle; the same conditions hold true as regards the circulation in Pulmonary Artery, the

Figure VI.

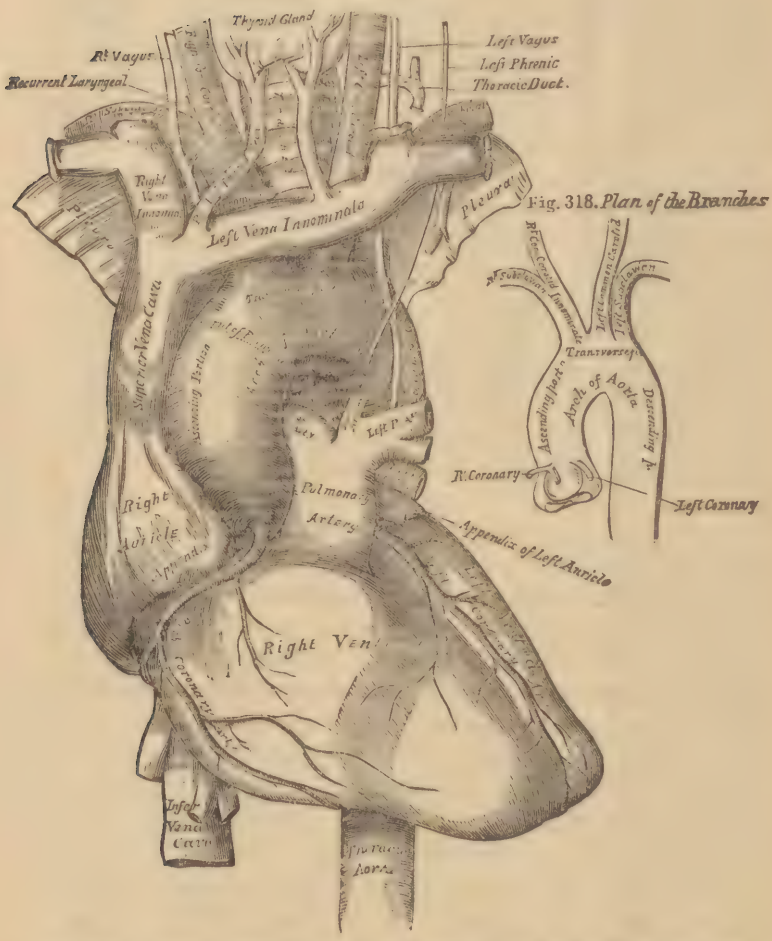


blood reaching outside of Artery must flow around that portion which flows on the side that adjoins the Aorta. Let us for a moment imagine Aorta and Pulmonary Artery straight and lying side by side as in following figure.

1, Pulmonary Artery; 2, Aorta; dotted lines 3 and 4, show these blood vessels dilated at systole of R. and L. ventricles, the adjoining walls A and B cannot dilate, blood is flowing in opposite directions as shown by arrows, therefore the blood on the outer sides of the blood vessels will flow more rapidly than that on the inner adjoining walls, as the pressure of one hinders the other. If we place these blood vessels at right angles to each other instead of having the currents running in opposite directions, as in diagram, we would, as can be readily seen, impart to each current a rotary motion and give each current a direction around the other.

On looking at following diagram of the heart and emerging arteries *in situ* we perceive that the *pressure* on the adjoining walls of Aorta and Pulmonary Artery tends to slow the forward movement of the respective currents, specially if the currents moved in straight direction, and also perceive that accepting the theory of a rotary current, each current accentuates the rotary action of the other, because they both rotate in the same direction. In short, the twisting of the Aorta around the Pulmonary Artery increases the rotary motion in each, because where the surfaces of the two vessels adjoin, there is brought about a loss of the forward speed (through intra-arterial *pressure* of each interfering with the other) and a shortening of the spiral of the rotary current (by the action of the one current on the other), *i. e.*, the blood rotates oftener in the same distance traveled forward. Just as the projectile which is fired from a rifled cannon forms a spiral through

Figure VII.



space, though revolving on its own axis, so the rotary moving blood forms a spiral outline on the wall of the artery containing it, though it revolves on its axis while moving forward.

HOW DOES THE ROTARY MOTION OF THE BLOOD MAKE A HOMOGENEOUS MASS OF THE SAME, PREVENT EDDIES, WHIRLS, CLOTS, ETC., AT ANGLES AND CURVES, PRESERVE FORM OF ARTERIES INTACT, AND KEEP THE INTRA-ARTERIAL PRESSURE THE SAME ON ALL SIDES OF THE ARTERY AT ITS ANGLES, CURVES AND BEGINNING OF BRANCHES?

If we analyze the rotary current of blood in the artery we are first impressed with the fact that the blood travels many times the length of the blood vessel insomuch as it travels spirally around it. Take now a molecule of this blood and we find that as soon as it reaches the outer wall of the current it is forced to revolve towards the center and thence outwards to the wall of blood vessel to again revolve towards the center and repeat this until the elasticity of artery is lost or becomes so little as to have no effect on the current. Graphically, it follows a course very similar to a serles of double mattress springs placed end to end, as in Figure 8.

Figure VIII.

A transverse section of a rotary moving current would therefore show a spiral thus

Figure IX.

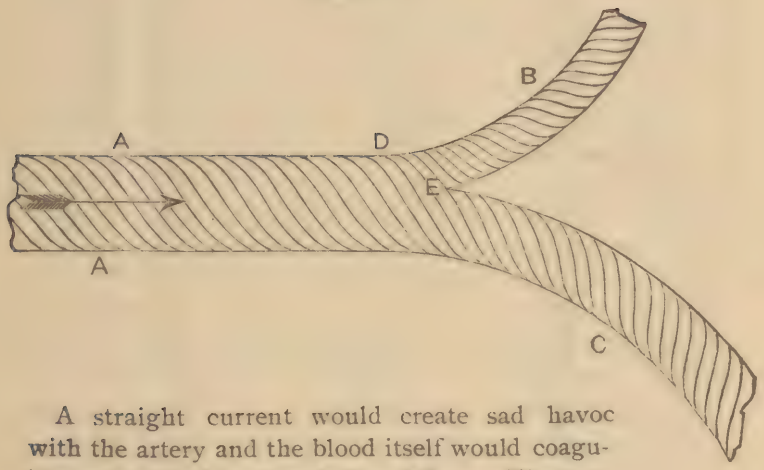
It is this division into fine layers and minute molecular movement of the blood which allows of such rapid and thorough diffusion of the different constituents of the blood into one homogeneous mass, probably before leaving Pulmonary Artery or ascending Aorta. The coffee spoon must suggest itself to every reader. The ingeniousness of this force to produce a homogeneous mass of the various kinds of blood entering the heart and to do so rapidly thoroughly, without commotion or disturbance, is thus made plain. It is this rapid movement of the blood within itself, this constant molecular transposition of the outer layer of the current into the center and out again and again that probably prevents coagulation of the blood and not some unknown specific action of the living artery or quality of the serous lining of the arterial wall.

THE NECESSITY OF THE CENTRIFUGAL POWER OF THE BLOOD IN THE ARTERIES.

The blood current rotating on its axis possesses *sui generis* a centrifugal power in exact proportion to the rapidity of rotary movement increased by the intra-arterial pressure. This centrifugal power is absolutely necessary and indispensable to maintain a smooth-flowing current in a system of conduits such as the circulatory system represents (therefore the rotary motion of the blood is an existing fact, because it is necessary).

If we cause a rotary moving current to move in direction of arrow through tube A A and its branches B and C, (see figure 10), we readily perceive that the centrifugal power of the current will carry it into B and C without at all disturbing E, the point of junction of the branches B and C, and also the current and intra-arterial pressure at angle A D B is maintained just as well as on the opposite wall A C.

Figure X.



A straight current would create sad havoc with the artery and the blood itself would coagulate and thrombus or embolism follow. The centrifugal force of the blood current prevents disturbance of the circulation and destruction of the circulatory apparatus.

THE ELASTIC QUALITY OF THE ARTERIES.

The elasticity of the arteries is absolutely necessary to maintain and continue the rotary movement of the blood, *for no matter at what angle the blood strikes an already distended elastic wall of an artery it is thrown back to the opposite wall in a direction at, or nearly at, right angles to the longitudinal axis of the blood vessel.*

THE ROTARY MOTION AN AID TO THE LYMPHATIC CIRCULATION.

The tortuous course and exceeding length of the Thoracic Duct finds its explanation, strange as it may seem at first sight, in the rotary motion of the blood. The duct passes between the vertebral column and arch of Aorta, passes in its course towards the neck, behind

all arteries going up, and in front of artery in its course *downwards*. *It passes behind the transverse portion of arch of Aorta, where the blood is being forced from below upwards in its revolution around, and through Aorta.* A greater and better power [a powerful intermitting rotary current in front, and hard vertebral column in back of duct] is not needed to force the contents of duct upwards, and again it passes around the left subclavian artery in the same direction as the blood revolves going upwards behind the subclavian, and downwards in front of subclavian artery to enter subclavian vein.

The rotary motion of the Aortic current assists materially the circulation in right Pulmonary Artery, in the same way as it assists the thoracic duct current. The right pulmonary having to supply the larger lung can at least make use of this assistance, even if there is no necessity for it.

CORROBORATIVE EVIDENCE IN COMPARATIVE ANATOMY.

In the left ventricle of the heart of the ox we find two bones partly encompassing Aortic orifice, the larger partially contained in Mitral Valve, the smaller on opposite side of aortic opening. They both work on the double principle of (1) a bell-crank or rectangular lever, and (2) that of a screw-propeller. [Yet as to screw action with reverse methods, though same results, for the screw-propeller rotates itself and moves itself in the liquid, whereas these bones rotate and move the liquid passing over them. In the one the water maintains its position, in the other the bone retains its position.] Here in large animals where the blood must possess a very powerful initial velocity, the muscles of the ventricle are so powerful that bone adjuncts are necessary at angles, orifices and valves, to aid and protect the soft

tissues, as well as aid in rotating the blood. We find these bones so formed, and in such position as best fitted to these purposes; they form a system of what may be called *spiral rectangular levers* around the aortic opening, so that there should be no lessening of the force of the rotary current in changing its direction, and second, by means of their screw-blade form they accentuate the rotary motion. As can be seen, their position is most advantageous for this last purpose. By means of this rectangular lever action little or no current force is lost by the blood changing its course, for the impaction force of the blood on the mitral valve, instead of being transformed into heat or rendered a latent force, as when the blood current dilates an artery, is simply transported to the other arm of the lever in the aortic opening of the ventricle, which there strikes and helps to force the blood through this orifice. Each of these bones "mitral" and "aortic" is composed of two bones, the mitral bone, if it may be called such, the larger can be roughly described as a squatty Y shaped bone with short trunk and widely divergent stems; the trunk on which the bone pivots is nearly like a flattened, truncated cone, having two surfaces, slightly curving on each other, one convex, the other concave, so that the lever action is not only from side to side, but also from above down, the resultant being a spiral; it is buried in the muscular tissue of the left ventricle. One stem of this lever is long, thin, narrow and slightly curved, flat on convex side, possesses a triangular ridge on concave surface, and extends into and nearly to centre of mitral valve, the concave surface with triangular ridge faces cavity of left ventricle, the other surface the cavity of left auricle. To its upper border is attached a part of the Aortic valve. This branch is a separate bone with hinge joint to the rest of the bone, not

very moveable, but arches with mitral valve; the other stem is long, broad, thick and curved, representing, somewhat, as a whole, the form of a screw-propeller blade, and gives attachment with its long, superior border, to the base of an aortic valve, that aortic valve that has no coronary artery opening back of it, and over which the blood passes first on entering Aorta. This border is grooved, showing that the blood passes from right to left when passing over it from below upwards. [Therefore the blood rotates.] The short border at right angles to this superior border gives attachment to part of next aortic valve.

This bone has manifold duties to perform.

First. It strengthens the tissues making up the aortic orifice.

Second. It gives attachment to muscles and valves.

Third. It acts as a rectangular lever, or bell-crank, in transporting the current without loss of force around an angle.

Fourth. It not only transports the force around an angle, but transforms the short, rapid and intense, impulse force of the sudden impaction of the blood against Mitral Valve, to a longer, steadier, more graded, yet as powerful force, to be exerted on the blood current at the aortic orifice; this is done by the elastic quality of the mitral arm of the lever in contrast to the inelastic character of the aortic branch of this Y shaped bone.

Fifth. It accentuates the rotary movement of the blood by means of its spiral movement and its screw-propeller blade shape. At moment of systole of left

ventricle the aortic blade of this screw and lever acting bone faces the interior of the Aorta and the triangular concave surface of the mitral blade faces the cavity of left ventricle, therefore in nearly opposite direction.

The smaller of these two bell-crank bones is also composed of two bones; its action is very similar, but, as can be readily seen on account of the trunk on which it pivots being *broad* and *flat*, it only pivots in one direction from side to side, its screw-propeller blade form though is very pronounced. its functions are to act as lever and as screw, and thereby assists the larger bone.

SUMMARY.

This theory makes use of all the anatomical and physiological factors of the circulatory system known to medicine.

It explains many problems in the hydrostatics and hydrodynamics of the blood circulation unexplained up to now.

This theory makes use of and explains the reason for the existence of the following: [most of them without any apparent use except for this theory.]

1. The form of the heart as a whole; truncated cone apex below.

2. The fixed attachment of the heart at one end only, its base.

3. The relative freedom of the other end; its apex.

4. The powerful *twisting* central *cavity*; left ventricle.

5. The less powerful and *spiral* or *curving* outer cavity; right ventricle.

6. The blood currents in right and left ventricles running at right angles to each other

7. The different layers of muscles of the heart and the relation of one to the other.

8. The *bicuspid* arrangement of the valves of the left auriculo-ventricular opening and a large mitral valve.

9. The twisting on one another of the tendons to this valve.

10. The *tricuspid* arrangement of the valves of the right auriculo-ventricular opening, and all the cusps of equal size.

11. The absence of all tendons and muscles at aortic and pulmonary valves, and all being alike, just simple cusps. [In the auricles we have no centrifugal power in the blood, in the arteries we have.]

12. The spiral form of Pulmonary Artery.

13. The Arch of the Aorta and its spiral form.

14. The twisting of the Aorta and Pulmonary Artery on each other and at beginning at right angles to each other.

15. The passage of right Pulmonary Artery directly under arch of Aorta.

16. The length and roundabout course of the Thoracic Duct and its position between vertebral column and Arch of Aorta.

17. The elasticity of arteries.

18. The necessity of arteries to carry venous blood from the right ventricle.

19. The non-necessity and consequent absence of arteries to carry arterial blood to left auricle.

AS TO THE MECHANISM.

1. Given a system of elastic conduits as in the Arterial and Pulmonary, systems with a current of blood or any liquid flowing through them *under pressure*, this current must assume a rotary movement on account of the elasticity of the walls.

2. The cyclical forcible ingress of fluid is also sufficient to cause a rotary movement to this current.

3. The form, relative position to each other, arrangment of muscles and valves, etc., of the ventricles must be followed by a rotary movement of any fluid acted upon by them.

4. The Spiral course of Aorta and Pulmonary Artery must cause a current flowing through them to rotate.

5. The apposition and twisting of the Aorta and Pulmonary Artery on each other has same effect.

In the circulatory system all five factors work together to effect a perfect rotary motion in the circulating blood.

CONCLUSIONS.

In the foregoing we believe to have succeeded in proving, that, just as the Earth rotates on its axis while moving through space, so the blood rotates on its axis while moving through the arteries.

That this rotary movement of the blood with its consequent centrifugal power is absolutely necessary and indispensable to health and life.

That with the existing circulatory system none but a rotary moving current is possible.

That the coronary arteries can only receive their blood during systole of heart by means of a rotary blood current.

And that the semilunar valves of Aorta and Pulmonary Artery *are perfect valves only with a rotary current.* With a straight current these valves cannot possibly prevent regurgitation. In a rotary current with its centrifugal power, the valves *float* close together like a spiral staircase, and as soon as the blood passes beyond the valves, the centrifugal force of the current closes the valves together before the intra-arterial pressure in Aorta and Pulmonay Artery can possibly come into play.